

WHAT IS CLAIMED IS:

1. A method of calculating fuel flow adjustments for balancing combustion among cylinders of an internal combustion engine, comprising the steps of:
  - 5       measuring the peak firing pressure within each cylinder;
  - measuring the combustion pressure within each cylinder;
  - for each cylinder, calculating its associated
  - 10       normalized peak firing pressure (NPFP) as the ratio of its peak firing pressure to its combustion pressure;
  - determining a target NPFP for the engine;
  - comparing the target NPFP to the NPFP for each cylinder; and
  - 15       calculating a fuel flow adjustment to any cylinder whose NPFP is not substantially equal to the target NPFP.
2. The method of Claim 1, wherein the step of measuring peak firing pressure is performed by measuring
- 20       peak firing pressures for a number of cycles and averaging over those cycles.
3. The method of Claim 1, wherein the step of measuring combustion pressure is performed by measuring
- 25       combustion pressures for a number of cycles and averaging over those cycles.

4. The method of Claim 1, wherein the step of calculating each cylinders's NPFP is performed by calculating an average of ratios of its peak firing pressure to its combustion pressure.

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5. The method of Claim 1, wherein the target NPFP is the mean of the NPFP values calculated in the calculating step.

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6. The method of Claim 1, wherein the calculating, determining, and comparing steps are performed by a computer, and further comprising the step of displaying the results of the measuring steps on a computer display.

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7. The method of Claim 1, wherein the calculating, determining, and comparing steps are performed by a computer, and further comprising the step of displaying the results of at least one of the calculating steps on a computer display.

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8. The method of Claim 1, wherein the combustion pressure is measured at a crank angle of approximately 160 degrees.

9. A method of balancing combustion among cylinders of an internal combustion engine, comprising the steps of:

measuring the peak firing pressure within each  
5 cylinder;

measuring the combustion pressure within each cylinder;

for each cylinder, calculating its associated normalized peak firing pressure (NPFP) as the ratio of  
10 its peak firing pressure to its combustion pressure;

determining a target NPFP for the engine;

comparing the target NPFP to the NPFP for each cylinder;

calculating a fuel flow adjustment to any cylinder  
15 whose NPFP is not substantially equal to the target NPFP;  
and

adjusting the fuel flow in accordance with the calculating step.

20 10. The method of Claim 9, wherein the method is performed automatically by an embedded engine control unit.

11. The method of Claim 9, wherein the method is  
25 performed automatically by a computer system in electronic communication with fuel control valves or injectors.

12. The method of Claim 9, wherein the adjusting  
step is limited and further comprising the step of  
repeating the measuring, calculating, comparing, and  
adjusting steps until the NPFP of each cylinder is  
5 substantially equal to the target NPFP.

13. An interactive computer system for balancing combustion among cylinders of an internal combustion engine, each cylinder having an associated pressure sensor, comprising:

- 5       a processing system for receiving pressure measurements from the pressure sensors; for determining the peak firing pressure and the combustion pressure within each cylinder; for calculating each cylinder's associated normalized peak firing pressure (NPFP) as the  
10   ratio of its peak firing pressure to its combustion pressure; for determining a target NPFP for the engine; for comparing the target NPFP to the NPFP for each cylinder; and for calculating fuel control adjustment values based on the comparing step;
- 15       a computer display for displaying the fuel control adjustment values.

14. The system of Claim 13, wherein the display further displays pressure measurement values.

15. An automated combustion balancing system for balancing combustion among cylinders of an internal combustion engine, each cylinder having a pre-combustion fuel control valve, comprising:

5 a pressure sensor associated with each cylinder for measuring the peak firing pressure and the combustion pressure within each cylinder; and

a processing system for calculating each cylinder's associated normalized peak firing pressure (NPFP) as the  
10 ratio of its peak firing pressure to its combustion pressure; determining a target NPFP for the engine; comparing the target NPFP to the NPFP for each cylinder; and providing a control signal to the fuel flow valve to each cylinder, such that the fuel flow to any cylinder  
15 whose NPFP is not substantially equal to the target NPFP is adjusted; and

fuel control valves associated with each cylinder.

16. The system of Claim 15, wherein the processing  
20 system is part of an engine control unit.